Chapter 3 – The Metric System

Problems: 3, 7, 17, 25, 27, 31, 35, 37, 41, 47, 49, 53, 55, 57, 61, 69, 77, 83, 93

3.

	Unit	Symbol		Unit	Symbol
(a)	kilometer	km	(b)	gigagram	Gg
(c)	deciliter	dL	(d)	picosecond	ps

7.

	Instrument	Quantity		Instrument	Quantity
(a)	ruler	length	(b)	platform balance	mass
(c)	pipet	volume	(d)	stopwatch	time

17. (a) $1.00\ \cancel{\text{m}} \times \dfrac{1\ \text{km}}{1000\ \cancel{\text{m}}} = 1.00 \times 10^{-3}\ \text{km}$

(b) $100\ \cancel{\text{g}} \times \dfrac{100\ \text{cg}}{1\ \cancel{\text{g}}} = 1 \times 10^{4}\ \text{cg}$

(c) $0.100\ \cancel{\text{L}} \times \dfrac{10\ \text{dL}}{1\ \cancel{\text{L}}} = 1.00\ \text{dL}$

(d) $0.000\ 010\ \cancel{\text{s}} \times \dfrac{1 \times 10^{9}\ \text{ns}}{1\ \cancel{\text{s}}} = 1.00 \times 10^{4}\ \text{ns}$

25. (a) $72\ \cancel{\text{in.}} \times \dfrac{2.54\ \cancel{\text{cm}}}{1\ \cancel{\text{in.}}} \times \dfrac{1\ \text{m}}{100\ \cancel{\text{cm}}} = 1.8\ \text{m}$

(b) $175\ \cancel{\text{lb}} \times \dfrac{454\ \cancel{\text{g}}}{1\ \cancel{\text{lb}}} \times \dfrac{1\ \text{kg}}{1000\ \cancel{\text{g}}} = 79.5\ \text{kg}$

(c) $0.500\ \cancel{\text{qt}} \times \dfrac{946\ \cancel{\text{mL}}}{1\ \cancel{\text{qt}}} \times \dfrac{1\ \text{L}}{1000\ \cancel{\text{mL}}} = 0.473\ \text{L}$

(d) $1.05 \times 10^{-4}\ \cancel{\text{min}} \times \dfrac{60\ \cancel{\text{s}}}{1\ \cancel{\text{min}}} \times \dfrac{1\ \text{ks}}{1000\ \cancel{\text{s}}} = 6.30 \times 10^{-6}\ \text{ks}$

27. $\dfrac{13\ \cancel{\text{km}}}{1\ \cancel{\text{L}}} \times \dfrac{1\ \text{mi}}{1.61\ \cancel{\text{km}}} \times \dfrac{3.784\ \cancel{\text{L}}}{1\ \text{gal}} = 31\ \text{mi/gal}$

31. $$\frac{(15.3\ \text{cm}^3)}{(4.95\ \text{cm})\,(2.45\ \text{cm})} = \frac{(15.3\ \text{cm} \times \cancel{\text{cm}} \times \cancel{\text{cm}})}{(4.95\ \cancel{\text{cm}})\,(2.45\ \cancel{\text{cm}})} = 1.26\ \text{cm}$$

35. $$6.10\ \cancel{\text{L}} \times \frac{1000\ \cancel{\text{mL}}}{1\ \cancel{\text{L}}} \times \frac{1\ \cancel{\text{cm}}^3}{1\ \cancel{\text{mL}}} \times \left(\frac{1\ \text{in.}}{2.54\ \cancel{\text{cm}}}\right)^3 = 372\ \text{in.}^3$$

37. volume of piece of jade: $7.5\ \text{mL} - 4.5\ \text{mL} = 3.0\ \text{mL}$

41.

	Substance	Sink or Float		Substance	Sink or Float
(a)	ebony	sink	(b)	bamboo	float

47. (a) $$7.50\ \cancel{\text{cm}}^3 \times \frac{2.18\ \text{g}}{1\ \cancel{\text{cm}}^3} = 16.4\ \text{g}$$

(b) $$455\ \cancel{\text{cm}}^3 \times \frac{1.715\ \text{g}}{1\ \cancel{\text{cm}}^3} = 780\ \text{g}\ (7.80 \times 10^2\ \text{g})$$

49. (a) $$\frac{19.7\ \text{g}}{25.0\ \text{mL}} = 0.788\ \text{g/mL}$$

(b) $$\frac{11.6\ \text{g}}{4.1\ \text{mL}} = 2.8\ \text{g/mL}$$

53. (a) $$(100 - 32)\ \cancel{^\circ\text{F}} \times \frac{100\ ^\circ\text{C}}{180\ \cancel{^\circ\text{F}}} = 38\ ^\circ\text{C}$$

(b) $$(-215 - 32)\ \cancel{^\circ\text{F}} \times \frac{100\ ^\circ\text{C}}{180\ \cancel{^\circ\text{F}}} = -137\ ^\circ\text{C}$$

55. (a) $495\ ^\circ\text{C} + 273 = 768\ \text{K}$

(b) $-185\ ^\circ\text{C} + 273 = 88\ \text{K}$

57. Temperature is a measure of the *average* energy in a container and heat is a measure of the *total* energy in a container. (For example, a large chemistry lecture room at 20 °C has more heat energy than a small lecture room at 20 °C, even though the temperature is the same.)

61. $$25.0\ \cancel{\text{g}} \times \frac{0.108\ \text{cal}}{1\ \cancel{\text{g}} \times \cancel{^\circ\text{C}}} \times (50.0 - 25.0)\ \cancel{^\circ\text{C}} = 67.5\ \text{cal}$$

69. $$35\ \cancel{\text{ms}} \times \frac{1\ \cancel{\text{s}}}{1000\ \cancel{\text{ms}}} \times \frac{1 \times 10^6\ \mu\text{s}}{1\ \cancel{\text{s}}} = 3.5 \times 10^4\ \mu\text{s}$$

77. $$94.0\ \cancel{\text{feet}} \times \frac{1\ \cancel{\text{yard}}}{3\ \cancel{\text{feet}}} \times \frac{0.914\ \text{m}}{1\ \cancel{\text{yard}}} = 28.6\ \text{m}$$

$$50.0\ \cancel{\text{feet}} \times \frac{1\ \cancel{\text{yard}}}{3\ \cancel{\text{feet}}} \times \frac{0.914\ \text{m}}{1\ \cancel{\text{yard}}} = 15.2\ \text{m}$$

Playing area of a basketball court: $28.6\ \text{m} \times 15.2\ \text{m} = 435\ \text{m}^2$

83. $$\frac{1.00\ \cancel{\text{g}}}{1\ \cancel{\text{mL}}} \times \frac{1\ \text{lb}}{454\ \cancel{\text{g}}} \times \frac{1\ \cancel{\text{mL}}}{1\ \cancel{\text{cm}^3}} \times \left(\frac{2.54\ \cancel{\text{cm}}}{1\ \cancel{\text{in.}}}\right)^3 \times \left(\frac{12\ \cancel{\text{in.}}}{1\ \text{ft}}\right)^3 = 62.4\ \text{lb/ft}^3$$

93. $$10.0\ \cancel{\text{g}} \times \frac{0.0920\ \text{cal}}{1\ \cancel{\text{g}} \times\ ^\circ\text{C}} \times (T_{\text{final}} - 22.7\ ^\circ\text{C}) = 27.8\ \text{cal}$$

$$T_{\text{final}} - 22.7\ ^\circ\text{C} = 27.8\ \cancel{\text{cal}} / 0.920\ \cancel{\text{cal}} /\ ^\circ\text{C}$$

$$T_{\text{final}} - 22.7\ ^\circ\text{C} = 30.2\ ^\circ\text{C}$$

$$T_{\text{final}} = 30.2\ ^\circ\text{C} + 22.7\ ^\circ\text{C} = 52.9\ ^\circ\text{C}$$